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WADC TECHNICAL REPORT 55-340

SUPPLEMENT 1

ASTIA DOCUMENT No. AD 110524

FC

**A STUDY OF THE EFFECTS OF CHEMICALS
ON THE PROPERTIES OF PARACHUTE FABRICS**

DAVID M. CATES

SCHOOL OF TEXTILES

NORTH CAROLINA STATE COLLEGE

NOVEMBER 1956

WRIGHT AIR DEVELOPMENT CENTER

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WADC TECHNICAL REPORT 55-340
SUPPLEMENT 1
ASTIA DOCUMENT No. AD 110524

A STUDY OF THE EFFECTS OF CHEMICALS ON THE PROPERTIES OF PARACHUTE FABRICS

DAVID M. CATES

*SCHOOL OF TEXTILES
NORTH CAROLINA STATE COLLEGE*

NOVEMBER 1956

**MATERIALS LABORATORY
CONTRACT No. AF 33(616)-2530
PROJECT No. 7320**

**WRIGHT AIR DEVELOPMENT CENTER
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO**

FOREWORD

This report was prepared by the School of Textiles at the North Carolina State College of Agriculture and Engineering of the University of North Carolina and is a supplement to the technical report issued under Contract No. AF 33(616)-2530. The contract was initiated under Project No. 7320, "Air Force Textile Materials", Task No. 73201, "Textile Materials for Parachutes". The work was administered under the direction of the Materials Laboratory, Directorate of Research, Wright Air Development Center, with 1st Lt. Richard A. Sublette and Capt. Malcolm J. Rogers acting as co-project engineers.

The report, which covers work conducted from March 1956 to June 1956, presents statistical limits for some of the data given in Technical Report WADC TR 55-340 which was issued in June, 1956. Miss Shirley Slocum made the calculations.

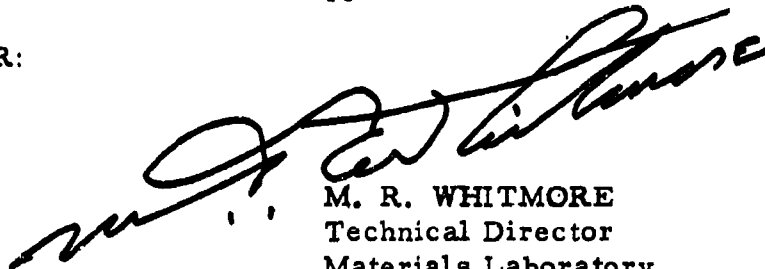
ABSTRACT

The results given in the Technical Report WADC TR 55-340 were obtained by determining the percent loss in strength of nylon and Dacron parachute fabrics when the fabric was treated with chemicals under various conditions. Because fabrics are not absolutely uniform and experimental procedures are not perfectly reproducible, the results of breaking strength tests varied. Since each sample consisted of several breaking tests (usually 10), it was possible to estimate the within sample reliability by statistical means. This was done by calculating the 95% confidence limits.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

A handwritten signature in black ink, appearing to read 'M. R. Whitmore', is written over the printed name and title.

M. R. WHITMORE
Technical Director
Materials Laboratory
Directorate of Research

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A STUDY OF THE EFFECTS OF CHEMICALS ON THE PROPERTIES OF PARACHUTE FABRICS SUPPLEMENT 1

Introduction

The objective of this work was the statistical analysis of data reported in Technical Report WADC TR 55 - 340. The experimental data were obtained by determining the percent loss in strength of nylon and Dacron fabrics when the fabric was treated with chemicals under various conditions. For example, a sample of fabric was treated under certain testing conditions and was then raveled into strips (usually 10) for breaking strength tests. Thus a result for a given sample was the average of the breaking tests performed on the raveled strips and was expressed in terms of percent loss in strength based on an untreated control.

Because fabrics are not absolutely uniform and experimental procedures are not perfectly reproducible, the results of breaking strength tests will vary. Since in the present case the average result for a sample consisted of several tests (one on each strip), it is possible to estimate the "test to test", or within sample, reliability. This was taken as the experimental error since tests on different samples of untreated Dacron (Types I and II) indicated that there was no appreciable sample to sample or time of testing variance.

An interpretation of the 95% confidence limits as applied to the present results is that the following interval:

Average breaking strength \pm limits
(Expressed as a percent of the average breaking strength of the untreated sample)

has a 95% probability of including the true breaking strength (expressed as a percentage of the average breaking strength of the untreated sample).

The confidence limits were calculated from the following formula:

$$\text{limits} = \pm \frac{100ts}{\Theta \sqrt{n}}$$

$$\text{where } s = \left\{ \frac{1}{n-1} \left[\sum X_i^2 - \frac{(\sum X_i)^2}{n} \right] \right\}^{1/2}$$

and X_i is the breaking strength of the i th test, n is the number of tests (usually 10), t is Student's "t" factor for 95% limits, and Θ is the breaking strength of the untreated sample.

The calculated 95% confidence limits are shown in the tables along with the average percent loss in strength obtained at each testing condition. The complete

Manuscript released by author June 1956 for publication as a WADC Technical Report.

details of the experimental data may be obtained from the original report (WADC TR 55-340). The data were obtained from two groups of experiments on nylon and Dacron fabric:

1. Prolonged ageing experiments under different conditions of concentration of acid and temperature.

2. Experiments designed to determine the effect of light in combination with the effect of acids.

Table I is shown in order to make it easy to relate the data in the original report with the data and concomitant limits shown in this one.

TABLE I

Data of WADC TR 55-340 compared with data of WADC TR 55-340 Suppl 1

	WADC TR 55-340 Supplement 1	WADC TR 55-340
Nylon treated and aged in solution:	TABLE	TABLE
H ₂ O	II	VIII
H ₂ SO ₄	II	IX
HCl	II	X
HNO ₃	II	XI
H ₃ PO ₄	II	XII
H ₂ SO ₃	II	XIII
H ₂ S	II	XIV
HNO ₂	II	XV
HNO ₂ Control	II	XVI

TABLE I (Continued)

WADC TR 55-340
Supplement 1

WADC TR 55-340

Nylon treated in solution
and aged at low relative
humidity

TABLE

TABLE

H_2O	III	VIII
H_2SO_4	III	IX
HCl	III	X
HNO_3	III	XI
H_3PO_4	III	XII
H_2SO_3	III	XIII
H_2S	III	XIV
HNO_2	III	XV
HNO_2 Control	III	XVI

Nylon treated in solution and aged
at high relative humidity

H_2O	IV	VIII
H_2SO_4	IV	IX
HCl	IV	X
HNO_3	IV	XI
H_3PO_4	IV	XII
H_2SO_3	IV	XIII
H_2S	IV	XIV
HNO_2	IV	XV
HNO_2 Control	IV	XVI

TABLE I (Continued)

WADC TR 55-340

Supplement 1

WADC TR 55-340

Dacron (Type I) treated and
aged in solution

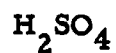
TABLE

TABLE



V

XXVI



V

XXVI



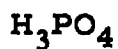
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XXVI



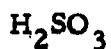
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XXVII



V

XXVII



V

XXVII



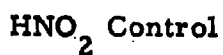
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XXVIII



V

XXVIII



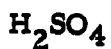
V

XXVIII

Dacron (Type II) treated and
aged in solution

VI

XVII



VI

XVIII



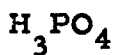
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XIX



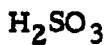
VI

XX



VI

XXI



VI

XXII



VI

XXIII



VI

XXIV



VI

XXV

TABLE I (Continued)

WADC TR 55-340
Supplement 1

WADC TR 55-340

Dacron (Type II) treated in
solution and aged at low
relative humidity

	TABLE
H ₂ O	VII
H ₂ SO ₄	VII
HCl	VII
HNO ₃	VII
H ₃ PO ₄	VII
H ₂ SO ₃	VII
H ₂ S	VII
HNO ₂	VII
HNO ₂ Control	VII

TABLE

XVII
XVIII
XIX
XX
XXI
XXII
XXIII
XXIV
XXV

Dacron (Type II) treated in solu-
tion and aged at high relative
humidity

H ₂ O	VIII
H ₂ SO ₄	VIII
HCl	VIII
HNO ₃	VIII
H ₃ PO ₄	VIII
H ₂ SO ₃	VIII
H ₂ S	VIII
HNO ₂	VIII
HNO ₂ Control	VIII

XVII
XVIII
XIX
XX
XXI
XXII
XXIII
XXIV
XXV

TABLE I (Continued)

WADC TR 55-340
Supplement 1

WADC TR 55-340

Nylon treated in solution and
exposed to light in Fade-Ometer

TABLE

TABLE

H ₂ O	IX	XXIX
H ₂ SO ₄	IX	XXIX
HCl	IX	XXIX
HNO ₃	IX	XXIX
H ₃ PO ₄	IX	XXIX
H ₂ SO ₃	IX	XXIX
HNO ₂	IX	XXIX
H ₂ S	IX	XXIX

Dacron (Type II) treated in
solution and exposed to light
in Fade-Ometer

H ₂ O	X	XXX
H ₂ SO ₄	X	XXX
HCl	X	XXX
HNO ₃	X	XXX
H ₃ PO ₄	X	XXX
H ₂ SO ₃	X	XXX
HNO ₂	X	XXX
H ₂ S	X	XXX

TABLE II

Loss in strength when nylon is treated and aged in solution

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ O	--	Room	1.0	1.5	+1.2	1.5
	--	100	1.2	2.9	+1.2	2.0
	--	120	1.0	2.9	0.7	0.9
	--	150	5.4	10.0	12.5	13.5
H ₂ SO ₄	0.056	Room	4.4	3.5	2.9	5.7
	0.023	100	3.7	4.9	9.3	17.0
	0.017	120	2.9	3.6	14.0	39.9
	0.021	150	24.8	57.2	81.3	90.4
HCl	0.057	Room	4.2	5.6	5.4	7.6
	0.033	100	5.2	4.4	10.3	11.5
	0.026	120	2.9	5.4	15.7	38.8
	0.012	150	4.4	6.1	9.8	16.7
HNO ₃	0.051	Room	7.6	14.2	15.0	19.4
	0.035	100	9.6	17.9	31.9	64.4
	0.016	120	5.7	13.5	22.1	42.3
	0.013	150	17.4	36.6	72.7	86.5
H ₃ PO ₄	0.11	Room	1.2	2.5	3.2	4.2
	0.055	100	2.9	2.7	6.4	7.6
	0.11	120	1.0	2.2	5.4	9.0
	0.012	150	8.1	9.8	16.5	28.3
H ₂ SO ₃	1.36	Room	2.9	8.8	9.3	4.7
	0.89	100	1.2	11.0	13.5	19.2
	0.58	120	1.2	11.3	10.3	20.9
	0.094	150	1.2	11.3	13.0	22.4
H ₂ S	0.18	Room	+0.7	0.7	+1.2	0.0
	0.14	100	+0.7	0.9	+0.5	1.7
	0.11	120	+0.7	3.9	0.0	+9.8
	0.08	150	0.7	0.0	2.0	4.4
			0.9	3.8	1.0	1.9

TABLE II (Continued)

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%)		Strength Loss (%)		Strength Loss (%)	
			Ageing Time 1 Month	Ageing Time 2 Months	Ageing Time 4 Months	Ageing Time 6 Months	Ageing Time 6 Months	Ageing Time 6 Months
HNO ₂	0.65	Room	14.7	10.3	19.1	25.0	12.9	
	0.40	100	11.3	10.0	16.9	17.9	3.2	
	0.30	120	11.1	18.6	36.1	32.4	6.6	
	0.20	150	2.9	4.4	6.3	10.0	3.1	
HNO ₂ Control	--	Room	1.0	0.9	0.7	2.0	1.0	
	--	100	3.4	4.1	7.6	9.3	3.4	
	--	120	2.9	8.1	14.2	65.1	1.7	
	--	150	4.9	67.3	74.7	85.3	3.0	

TABLE III

Loss in strength when nylon is treated in solution and aged at low relative humidity

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ O	--	Room	0.9	+1.2	12.3	18.9
	--	100	+0.7	+2.7	15.2	17.1
	--	120	0.7	0.0	7.1	7.4
	--	150	1.2	4.9	31.0	45.9
H ₂ SO ₄	0.058	Room	4.6	4.9	6.6	9.0
	0.024	100	4.6	2.9	8.1	*
	0.016	120	2.2	9.8	12.2	15.2
	0.012	150	9.8	28.7	25.6	36.6
HCl	0.054	Room	2.0	7.6	5.1	9.0
	0.033	100	1.4	10.5	12.5	18.6
	0.027	120	8.5	33.6	44.7	75.4
	0.012	150	7.7	26.2	33.9	36.6
HNO ₃	0.034	Room	10.0	14.2	11.8	13.3
	0.025	100	12.7	13.2	18.7	21.9
	0.016	120	10.8	16.2	20.4	33.2
	0.010	150	18.9	33.1	41.8	41.5
H ₃ PO ₄	0.11	Room	1.2	5.2	3.7	5.4
	0.069	100	2.7	7.3	13.3	10.0
	0.034	120	1.4	14.7	12.0	24.0
	0.009	150	7.6	16.2	29.7	40.7
H ₂ SO ₃	1.19	Room	0.2	5.4	+0.7	0.2
	0.86	100	0.7	2.2	6.1	11.3
	0.58	120	1.4	8.8	4.7	11.0
	0.097	150	8.8	27.7	34.9	36.1
H ₂ S	0.18	Room	4.7	0.5	+0.2	+0.2
	0.14	100	1.5	+3.7	1.7	4.2
	0.11	120	3.4	1.9	4.2	2.9
	0.08	150	14.7	22.1	23.0	28.5

TABLE III (Continued)

Reagent	Initial Conc. \bar{N}	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
HNO ₂	1.0	Room	0.7	1.7	0.0	3.2
	1.0	100	1.0	5.8	4.2	12.0
	1.0	120	11.0	28.5	69.0	67.0
	1.0	150	6.1	19.2	19.2	30.2
HNO ₂ Control	--	Room	0.0	6.3	+2.0	3.7
	--	100	7.3	6.4	0.2	13.0
	--	120	5.9	16.9	27.8	25.0
	--	150	5.7	20.8	19.4	31.2
						4.1
						7.6
						6.2
						5.5

* This result was not obtained because the sample was discarded by mistake at the end of the 4th month ageing period.

TABLE IV

Loss in strength when nylon is treated in solution and aged at high relative humidity

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ O	--	Room	+0.5	+1.2	0.7	+0.7
	--	100	3.4	+0.2	1.4	2.0
	--	120	7.6	+1.2	0.8	3.4
	--	150	3.9	0.5	0.9	0.2
H ₂ SO ₄	0.058	Room	5.1	6.1	2.9	9.0
	0.024	100	20.8	24.3	15.4	21.6
	0.016	120	4.6	3.1	2.7	8.3
	0.012	150	3.7	2.2	2.4	20.6
HCl	0.049	Room	4.1	5.8	3.1	4.1
	0.032	100	4.9	1.2	0.7	4.9
	0.028	120	2.9	4.4	1.4	5.4
	0.014	150	2.2	2.4	1.5	11.3
HNO ₃	0.033	Room	13.2	25.5	7.3	26.8
	0.022	100	42.5	49.4	7.7	52.3
	0.016	120	12.0	28.7	5.3	18.2
	0.013	150	55.2	38.0	13.6	80.3
H ₃ PO ₄	0.11	Room	0.2	0.0	0.8	0.9
	0.069	100	0.2	0.0	0.9	0.9
	0.034	120	0.7	1.9	3.2	*
	0.009	150	2.4	2.7	1.1	--
H ₂ SO ₃	1.19	Room	20.0	18.1	1.3	3.2
	0.86	100	34.4	34.6	2.1	23.0
	0.58	120	33.4	34.6	5.3	39.8
	0.097	150	86.2	77.1	5.6	100.0
H ₂ S	0.18	Room	0.2	0.0	1.7	0.9
	0.14	100	+0.5	+1.2	0.5	+0.5
	0.11	120	+1.2	0.5	1.4	2.2
						0.8

TABLE IV (Continued)

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
HNO ₂	0.08	150	0.9	16.9	10.6	7.1
	1.0	Room	8.1	15.9	11.5	2.9
	1.0	100	10.3	1.7	4.9	1.3
	1.0	120	4.9	28.7	100.0	5.2
	1.0	150	20.8	41.0	57.6	100.0
HNO ₂ Control	--	Room	0.7	0.5	0.7	2.1
		100	2.4	3.4	5.1	1.2
		120	2.2	2.4	7.1	2.5
		150	34.1	54.1	70.0	60.9
			0.1	9.5	6.9	8.4

* This result was not obtained because the sample was discarded by mistake at the end of the 4th month ageing period.

** Because the original data were misplaced the 95% confidence limits could not be obtained.

TABLE V

Loss in strength when Dacron (Type I) is treated and aged in solution

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ O	--	Room	+2.9	0.2	2.3	0.2
	--	100	1.8	+1.8	1.8	+0.7
	--	120	+0.5	1.0	2.3	0.2
	--	150	2.9	+2.1	0.8	7.1
H ₂ SO ₄	5.05	Room	4.7	10.0	17.2	8.2
	5.05	100	11.9	4.2	+0.5	11.9
	5.05	120	21.9	4.2	6.6	8.4
	5.05	150	6.6	8.9	15.5	18.2
HCl	4.98	Room	7.7	5.5	10.6	18.2
	4.98	100	15.6	25.0	46.7	65.4
	4.98	120	20.1	32.7	47.8	68.3
	2.32	150	43.5	96.0	100.0	100.0
HNO ₃	2.60	Room	4.5	6.3	17.6	36.1
	2.16	100	17.2	21.3	39.0	40.9
	2.16	120	14.8	27.9	44.8	54.0
	1.07	150	16.1	26.1	49.0	61.0
H ₃ PO ₄	4.92	Room	2.9	5.5	6.3	7.1
	4.92	100	1.3	4.2	4.5	9.8
	4.92	120	5.5	0.2	2.9	10.3
	2.16	150	+1.3	0.8	6.6	5.8
H ₂ SO ₃	1.36	Room	3.2	+1.5	4.2	2.9
	0.89	100	1.8	5.2	0.8	2.6
	0.58	120	0.5	+4.2	+6.0	7.6
	0.094	150	+1.6	0.7	4.0	6.5

TABLE V (Continued)

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ S	0.18	Room	0.8	3.6	0.8	4.5
	0.14	100	+2.4	0.0	+2.4	+0.2
	0.11	120	2.4	0.0	0.0	9.8
	0.08	150	10.3	3.6	1.3	10.8
HNO ₂	1.00	Room	0.5	1.0	2.9	+0.2
	1.00	100	3.4	2.1	+1.3	11.0
	1.00	120	6.1	3.1	3.0	7.9
	1.08	150	+2.4	+1.6	2.4	7.1
HNO ₂ Control	1.00	Room	2.9	+2.1	1.8	9.2
	1.00	100	4.7	5.5	5.3	4.5
	1.00	120	1.0	8.1	+0.8	4.5
	1.00	150	3.2	4.2	20.8	17.9

TABLE VI

Loss in strength when Dacron (Type II) is treated and aged in solution.

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ O	--	Room	4.2	2.5	6.9	+2.7
	--	100	+3.2	0.0	7.7	+4.7
	--	120	17.0	1.7	11.1	+2.7
	--	150	13.6	3.0	17.8	+0.2
H ₂ SO ₄	5.05	Room	+0.2	3.3	+1.5	+0.5
	5.05	100	1.7	5.2	1.7	0.2
	5.05	120	4.1	7.4	6.6	14.4
	5.05	150	4.6	14.4	20.5	24.8
HCl	4.98	Room	8.2	7.4	0.2	11.6
	5.18	100	9.1	22.5	*	*
	4.98	120	15.0	24.7	33.1	87.8
	2.49	150	38.6	30.8	68.0	100.0
HNO ₃	2.81	Room	9.2	21.7	2.7	23.0
	2.40	100	15.6	39.6	44.8	57.4
	2.30	120	13.1	21.5	31.4	81.4
	1.002	150	16.8	14.6	58.9	87.8
H ₃ PO ₄	4.92	Room	+0.7	6.1	0.9	+3.4
	4.92	100	3.2	2.8	14.9	+3.9
	4.92	120	+1.9	0.9	14.4	+1.2
	1.98	150	0.7	0.9	16.3	10.9
H ₂ SO ₃	1.2	Room	2.9	1.0	1.2	+4.9
	0.9	100	+1.7	1.5	+0.1	+4.9
	0.6	120	1.4	+3.7	1.2	+3.4
	0.1	150	1.4	6.9	3.9	+0.4
			5.8	4.8	5.4	1.8
			20.7	3.8	4.6	3.1
			4.3	5.2	3.5	2.0
			2.0	6.0	3.5	1.8
			4.7	5.5	1.4	2.4
			2.9	6.3	5.3	1.1
			4.1	7.9	3.2	3.0
			6.8	1.5	5.1	1.1
			3.7	4.8	4.1	2.2
			3.4	2.6	--	--
			2.3	2.7	6.7	1.6
			8.0	2.2	0.9	--
			7.3	2.1	3.7	3.0
			3.8	3.5	9.0	1.9
			2.8	5.7	3.1	0.5
			5.1	4.3	10.4	1.0
			2.4	5.0	6.3	2.4
			3.9	6.2	4.8	3.2
			7.0	4.4	2.8	1.2
			4.8	3.8	4.7	1.6
			6.4	4.6	4.7	1.4
			3.4	5.2	4.5	1.9
			4.3	3.3	3.4	1.5
			2.7	3.0	4.0	3.2

TABLE VI (Continued)

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ S	0.18	Room	3.5	14.3	3.7	2.5
	0.14	100	+ 0.2	12.1	0.7	+ 0.7
	0.11	120	+ 3.0	10.1	3.7	7.7
	0.08	150	+ 5.2	12.6	3.2	4.5
HNO ₂	1.0	Room	8.9	2.7	7.0	+ 3.9
	1.0	100	5.1	4.3	10.9	+ 2.9
	1.0	120	3.9	4.9	12.9	5.2
	1.0	150	11.6	4.4	13.6	9.4
HNO ₂ Control	--	Room	2.7	3.4	5.4	+ 3.2
	--	100	3.2	1.5	3.5	+ 5.0
	--	120	4.8	5.7	9.7	+ 1.2
	--	150	4.2	+ 2.0	7.7	13.9
			4.1	3.2	16.3	

* This result was not obtained because the sample was discarded before its breaking strength was determined.

TABLE VII

Loss in strength when Dacron (Type II) is treated in solution and aged at low relative humidity.

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%)		Strength Loss (%)		Strength Loss (%)		Strength Loss (%)	
			Ageing Time 1 Month	2 Months	Ageing Time 2 Months	4 Months	Ageing Time 4 Months	6 Months	Ageing Time 6 Months	
H ₂ O	--	Room	0.5	+1.5	6.2	4.4	4.8	1.5	4.4	
	--	100	+2.0	0.4	5.4	7.4	6.6	1.2	3.3	
	--	120	+2.2	+0.8	4.1	10.1	5.9	12.4	4.7	
	--	150	+1.0	0.8	4.3	12.6	5.1	9.9	4.8	
H ₂ SO ₄	2.14	Room	5.9	9.9	2.6	+2.5	8.1	5.1	3.8	
	2.14	100	26.4	34.1	12.0	77.2	4.9	63.3	1.2	
	0.056	120	9.9	30.6	7.6	6.4	7.8	43.3	16.4	
	0.056	150	34.4	50.4	18.6	62.4	29.0	100.0	--	
HCl	4.98	Room	29.9	16.8	5.6	10.9	8.0	34.4	6.0	
	4.98	100	31.6	18.8	3.8	12.1	12.2	26.7	8.3	
	4.98	120	34.6	20.0	5.5	19.0	5.8	32.4	7.3	
	4.98	150	25.4	24.2	4.5	18.8	5.4	33.6	3.9	
HNO ₃	2.48	Room	18.3	17.8	5.3	11.9	3.2	17.6	8.2	
	2.21	100	21.0	24.2	5.7	20.8	4.9	20.2	6.1	
	2.21	120	19.3	21.2	5.9	20.8	7.7	25.9	4.6	
	2.21	150	23.0	13.8	5.7	12.9	7.5	6.7	5.4	
H ₃ PO ₄	4.92	Room	1.7	9.9	6.1	8.6	5.4	0.2	4.4	
	4.92	100	1.0	+1.2	6.5	1.2	3.4	1.7	3.3	
	4.92	120	+3.2	6.9	3.6	29.4	10.4	42.8	21.2	
	0.69	150	4.5	6.6	3.9	10.9	3.9	20.7	4.1	
H ₂ SO ₃	1.19	Room	12.6	12.8	6.8	5.0	5.2	14.4	3.4	
	0.86	100	10.1	9.6	5.1	17.6	7.4	32.9	10.4	
	0.59	120	13.8	14.6	5.2	47.0	16.4	26.7	6.2	
	0.097	150	6.1	9.6	4.2	3.7	4.2	27.9	12.3	
H ₂ S	0.18	Room	2.0	11.1	5.3	5.9	6.7	3.4	5.1	
	0.14	100	1.2	17.3	3.3	11.4	5.7	7.4	5.1	
	0.11	120	2.5	23.0	4.0	6.4	5.2	51.5	14.6	

TABLE VII (Continued)

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ S	0.08	150	12.4	15.8	9.7	5.9
HNO ₂	1.0	Room	6.4	4.9	2.7	4.9
	1.0	100	6.6	7.1	5.9	0.2
	0.5	120	7.1	5.9	7.4	10.4
	0.2	150	8.1	8.9	13.4	6.9
HNO ₂						
Control	--	Room	6.4	4.5	9.6	5.9
	--	100	7.9	5.4	9.9	7.9
	--	120	2.2	5.4	6.9	11.4
	--	150	6.9	2.7	6.4	5.9
			18.4	3.7	5.5	3.0

TABLE VIII

Loss in strength when Dacron (Type II) is treated in solution and aged at high relative humidity.

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%)		Strength Loss (%)		Strength Loss (%)		Strength Loss (%)	
			Ageing Time 1 Month		Ageing Time 2 Months		Ageing Time 4 Months		Ageing Time 6 Months	
H ₂ O	--	Room	3.2	3.4	4.4	5.5	+ 1.2	2.5	+ 3.9	1.4
	--	100	7.4	8.4	1.9	6.1	4.0	3.5	+ 4.9	2.0
	--	120	2.7	3.7	4.4	5.8	1.2	2.6	+ 3.2	2.4
	--	150	8.4	4.8	0.9	4.0	4.7	2.3	6.2	6.1
H ₂ SO ₄	2.14	Room	1.7	2.8	8.4	1.8	1.0	2.7	0.0	3.1
	2.14	100	+2.0	2.9	7.6	3.2	0.0	3.8	+ 1.0	6.1
	0.056	120	0.7	2.8	10.8	4.8	3.2	4.1	9.2	4.4
	0.056	150	5.4	4.8	11.6	7.4	21.5	11.8	24.0	13.7
HCl	4.98	Room	2.0	5.8	13.3	4.1	16.3	4.8	27.2	3.2
	4.98	100	17.8	3.8	39.6	6.3	57.0	1.4	73.7	1.6
	4.98	120	11.1	3.4	24.7	2.7	63.9	2.4	92.0	5.1
	4.98	150	83.7	7.3	88.3	7.7	83.6	16.0	100.0	--
HNO ₃	2.49	Room	7.4	1.7	13.6	4.2	26.0	2.4	40.3	2.2
	2.21	100	17.3	4.6	23.7	4.6	49.0	2.8	51.0	1.5
	2.21	120	13.8	3.4	31.1	6.4	60.5	2.5	71.5	10.8
	2.21	150	84.9	6.0	76.9	9.9	80.9	2.5	100.0	--
H ₃ PO ₄	4.92	Room	1.4	2.6	+ 0.4	4.1	1.7	3.2	0.2	3.4
	4.92	100	3.2	4.7	+ 0.2	1.9	2.7	2.8	2.5	2.2
	4.92	120	6.4	3.6	+ 3.2	4.0	+ 1.0	3.6	+ 1.5	2.4
	0.70	150	6.1	3.9	8.6	4.0	3.5	4.1	11.6	2.9
H ₂ SO ₃	1.19	Room	3.7	4.4	+ 0.2	5.1	+ 3.2	2.7	+ 3.2	1.9
	0.86	100	4.7	4.0	+ 1.2	2.6	2.5	3.6	0.7	2.9
	0.58	120	9.1	6.4	+ 0.4	9.7	1.7	1.9	+ 0.2	4.7

TABLE VIII(Continued)

Reagent	Initial Conc. N	Temp. °F.	Strength Loss (%) Ageing Time 1 Month	Strength Loss (%) Ageing Time 2 Months	Strength Loss (%) Ageing Time 4 Months	Strength Loss (%) Ageing Time 6 Months
H ₂ SO ₃ H ₂ S	0.097	150	16.0	12.3	19.3	17.0
	0.18	Room	2.2	1.7	+2.0	+0.7
	0.14	100	1.9	2.9	0.0	3.7
	0.11	120	+4.4	+0.2	+1.2	+6.7
	0.08	150	4.9	8.1	2.5	0.7
HNO ₂	1.0	Room	0.9	1.2	+0.7	+1.2
	1.0	100	5.4	2.2	3.0	2.2
	0.5	120	+2.4	11.9	1.0	+0.5
	0.2	150	+0.2	+1.0	1.7	+2.9
					18.3	6.3
HNO ₂ Control	--	Room	3.4	1.0	5.0	+3.5
	--	100	0.9	3.2	7.7	1.2
	--	120	3.4	3.4	6.1	+0.5
	--	150	3.9	9.1	16.6	11.4
						2.5

TABLE IX

Loss in strength when nylon is treated in different solutions and exposed to light in the Fade-Ometer

Reagent	Conc. \bar{N}	Strength Loss (%) Ageing Time 10 Hours	Strength Loss (%) Ageing Time 20 Hours	Strength Loss (%) Ageing Time 40 Hours	Strength Loss (%) Ageing Time 80 Hours
H ₂ O	--	29.2	44.0	63.9	75.4
H ₂ SO ₄	0.1	42.8	53.0	67.8	79.1
HCl	1.0	56.3	72.2	76.2	83.0
	0.1	65.6	74.4	77.9	96.6
	1.0	79.6	90.2	92.9	100.0
HNO ₃	0.1	70.3	73.5	72.5	85.3
	1.0	80.8	78.1	86.0	91.1
H ₃ PO ₄	0.1	53.8	63.1	72.7	91.4
	1.0	40.0	51.6	71.0	81.0
H ₂ SO ₃	1.0	32.9	51.4	67.0	82.8
HNO ₂	1.0	34.4	35.6	46.4	68.5
H ₂ S	0.1	35.1	37.8	53.3	77.4
HNO ₂					
Control*					

* Since only 12 samples could be run in the Fade-Ometer simultaneously, the HNO₂ Control sample was omitted. It is probable that the loss of strength for the HNO₂ Control would fall near, or perhaps between, the values obtained with the water and HNO₂ samples.

TABLE X

Loss in strength when Dacron (Type II) is treated in different solutions and exposed to light in the Fade-Ometer

Reagent	Conc. N.	Strength Loss (%) Ageing Time 40 Hours	Strength Loss (%) Ageing Time 80 Hours	Strength Loss (%) Ageing Time 160 Hours	Strength Loss (%) Ageing Time 320 Hours
H ₂ O	--	13.4	12.1	17.0	14.6
H ₂ SO ₄	1.0	49.5	37.6	72.0	100.0
	5.0	51.5	68.3	100.0	100.0
HCl	1.0	11.6	21.0	57.1	26.7
	5.0	12.6	19.3	29.4	24.8
HNO ₃	1.0	9.4	16.8	32.6	21.5
	5.0	15.3	18.3	26.4	21.0
H ₃ PO ₄	1.0	9.7	10.1	11.1	16.3
	5.0	9.4	11.1	19.5	16.8
H ₂ SO ₃	1.0	17.6	18.3	13.4	15.8
HNO ₂	1.0	17.1	22.0	27.9	24.5
H ₂ S	0.1	16.6	14.6	16.8	12.9
HNO ₂					
Control*					

* Since only 12 samples could be run in the Fade-Ometer simultaneously, the HNO₂ control sample was omitted. It is probable that the loss of strength for the HNO₂ control would fall near, or perhaps between, the values obtained with the water and HNO₂ samples.